DOCUMENT RESUME

ED 280 450 IR 012 586

AUTHOR Kuznetsov, Valentin M.
TITLE New Information Technologies and Education in the USSR: Theory and Practice.
INSTITUTION United Nations Educational, Scientific, and Cultural Organization, Paris (France). Div. of Structures, Content, Methods and Techniques of Education.
PUB DATE 85
NOTE 44p.
PUB TYPE Information Analyses (070) -- Viewpoints (120) -- Reports - Descriptive (141)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Aesthetic Values; *Cognitive Processes; *Computer Assisted Instruction; *Computer Managed Instruction; Distance Education; *Educational Television; Epistemology; Feedback; Higher Education; Learning Motivation; *Multimedia Instruction; Production Techniques; Student Evaluation; Videotape Recordings
IDENTIFIERS *USSR

ABSTRACT

Focusing on computers and television and their applications both on campus and for distance education, this Unesco report on the role of instructional media in the system of higher education in the USSR argues that the new technologies are capable of performing three main instructional functions within the context of any teaching-learning process: (1) they create favorable conditions for teaching and learning; (2) they provide the teacher with an efficient tool with which to manage the learning process; and (3) they serve as a vehicle to implement the curriculum content. This discussion of both the use of media and the instructional theory involved in its use covers training for specialists in computer technology; ways in which computers are used in institutions of higher education in the USSR, including the use of monitoring feedback equipment in lecture halls and a computer-managed television-based instruction system (ATOC); ways in which visual presentation of abstractions can be used to enhance instruction in mathematics and science; advantages of satellite television for distance education, including the provision of cues that emphasize different elements of the instructional message, and the use of visual information to reflect reality as fully and as objectively as possible; and the role of aesthetic education of students in the formation of their professional skills. It is concluded that the contemporary teaching-learning process at any level of education is liable to lack efficiency unless it rests on the scientifically sound use of new technologies. (BBM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

Division of Structures, Content, Methods and Techniques of Education

Paris, 1985
Original: English

NEW INFORMATION TECHNOLOGIES AND EDUCATION IN THE USSR: Theory and practice

by Valentin M. KUZNETSOV
Prof., Dr. of Education,
Vice-Director
Moscow, 1985

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

Minor changes have been made to improve reproduction quality.

Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Suzanne Adlung

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Unesco, Paris

Reproduced by permission of

UNESCO

Paris, 1985
Original: English

NEW INFORMATION TECHNOLOGIES AND EDUCATION IN THE USSR: Theory and practive

by Valentin M. KUZNETSOV
Prof., Dr. of Education,
Vice-Director
Moscow, 1985

Study prepared under contract with UNESCO

The intensification of the teaching-learning process is a major element in current educational development. The use of technical aids, especially the most modern ones such as computers, television and videorecording, is among the factors usually quoted as conclusive to such intensification.

The instructional media play the same role in teaching-learning activity as to implements in any production process. The efficiency and eventual result of instruction depend in a large measure on the extent of their development and use.

The growing dependence of the instructional process on modern technologies is a conspicuous trend in the development of contemporary educational systems, and a result of the scientific and technological revolution. Some experts believe that the penetration of technical aids in educational practice is as significant an event as was the creation of the first school textbooks. However, when one emphasizes the need to modernize instruction one must not overlook the need to continue developing the traditional elements of the educational system, especially textbooks. Technology as such cannot guarantee success; it merely enriches and perfects teaching methods on a scientific basis. The introduction of new, more rational and intensive methods of teaching in the teaching-learning process is associated with the application of modern technologies, specifically the computer, television and videorecording.

Large-scale research and testing is being carried out in higher educational establishments in the USSR, to raise the quality of specialists training through planned introduction of new forms and methods of teaching, including problem-solving, audio-visual, research-oriented, programmed and simulation-game methods. They are all employed in institutions of higher learning (VUZes)* to provide such learning conditions in which the student

---

* Hereinafter the acronym VUZ will stand to denote an institution of higher learning in the USSR.

would be effectively motivated for cognitive activity.

New methods of teaching can only produce the optimum effect if they use modern technology. The new technologies are by no means a panacea for all educational problems, but we have learned that they can contribute much to the perfection of the educational process.

The more diversified the new technologies grow the wider is the range of instructional goals that can be aimed at through the application of such technologies, and consequently the more difficult it becomes to group the various technologies with a view to assessing their instructional resources scientifically.

None the less we can attribute certain common instructional functions to all new technologies.

The new technologies are capable of performing three main instructional functions within the context of any teaching-learning process:

a) they create favourable even optimal conditions for teaching and learning;
b) they provide the teacher with an efficient tool with which to manage the learning process;
c) they serve as a vehicle to implement the curriculum content.

The term "new technologies in education" embraces those technologies which incorporate in the shape of various devices the technical possibilities of recording, storing, transmitting and playing back information in an audio and/or visual form.

In this study we shall confine the range of technologies to be considered to computers and to some extent to videorecording and television. It is these media that possess the most powerful potential in the terms of the definitions given above.

New technologies are used at all levels - pre-school, school, university, post-graduate, but naturally on different ways at each

level. The technologies under consideration can serve all the levels of education enumerated above, but again - in order to be as specific as possible in instructional applications we shall not go beyong the sub-system of higher education in its two principal varieties - on campus and correspondence (distant) education.

Thus it all comes to computers, videorecording, television, and their application in higher education.

Prominent among modern technologies are computers. Learning situations which involve the use of computers stimulate activeness on the part of learners and boost substantially the range of possible tasks to be solved. Computers make it possible for calculattions to be optimized, and for new technological processes to be designed. High speed of operation, impressive memory, data processing capacity - these are some of the features that make the computer a powerful tool for raising the efficiency of teaching.

Since the computer was invented some three decades ago, four generations of computers have been developed with enhanced performance characteristics and cost-effectiveness.

The fourth generation of computers, based on large-scale integrated circuits (LSI), which appeared in the early 1970s, has substantially changed the parameters of computers of all classes. At the same time LSI gave rise to computing technology of an entirely new class - microprocessors - which took root in higher educattion: The next step was made in the late 1970s, when all computing elements were synthesized in one chip, giving birth to a single-chip microcomputer.

Specialists in computing technology are trained in the USSR under a curriculum which provides for (a) basic training aimed at giving students all necessary knowledge about computers and developing in them habits of devising and using programme for solving problems on the computer, and (b) specialized training which is intended to broaden the student's knwoledge and practical experience with microprocessors, and to ensure that he should master methods of using computers for designing, managing production and technological processes, and conducting research.

Three levels of basic training have been set for specialists in the field of computer technology.

Level I provides for the student to get an idea of what computers and microprocessors are capable of with regard to his professional field, master elementary skills of computation, learn to design a program of problem-solving in one of the algorithmic languages and prepare it for execution on the computer. The syllabus which supports this level of training includes notions of simulation and its specific applications and general teaching about computers and microprocessors and their capacities. It stipulates that one or two algorithmic languages should be studied, numerical methods of problem solving should be mastered, and general notions about specific computer networks and task management should be formed. It is laid down in the syllabus that the student should independently solve ten to fifteen problems on the computer. To make the skills thus developed more durable the student is supposed to solve one or two additional problems each semester - both with programmes devised by himself or with standard software. The total amount of study time envisaged in the Level I curriculum fits within 60 to 100 hours, of which more than a half are earmarked for seminars and laboratory practice.

Level II aims at having the would-be specialists obtain knowledge about the capacities of the computer and microprocessor as instruments of research, automatic data processing, and scientific and technological problem-solving; and to master methods of developing algorithms of problem solving and simulating processes and phenomena occuring in his professional field. The curriculum for this level's training teaches the use of algorithmic programming languages, and knowledge of the architecture and software of microprocessing systems. The study prescribed for this level of training may include such items as operating systems (purpose, set-up, functions, basic components, job control languages), programme libraries and application packages and management of processes. As a result of training for Level II the student is expected to expand substantially his knowledge in the field of the algorithmization of

problems and their simulation. To achieve this end the syllabus provides for such questions to be studied as the background of the theory of simulation, methods of creating mathematical models, formalizing processes and objects, and devising algorithms to solve optimization problems. In a course paper on the fundamentals of algorithmization students are required to solve 25 to 30 problems. It is deemed advisable that the student should solve at least two problems on the computer each semester. The total amount of study time provided for Level II is between 120 to 250 hours.

Level III provides that the student should master the methods of system programming, optimization methods of problem solving, and solving, and knowledge of methods of data organization in the computer. He or she should also acquire skills in developing application packages, and the ability to devise and debug programmes for a microprocessor set. Level III training is supported by the provision of such projects as "Programming", "Simulation and algorithmization of problem solving", "ED and CM hardware", "Micro- and minicomputers" and "Organization of computing systems". The content of these subjects, including all the instructional material for Level II, includes a comprehensive study of algorithmic languages, questions of simulation, and microprocessor facilities. The content of training for this level also includes organization of computing processes in the computers and computer networks, peculiar features of developing complex-structure programmes, software for time-sharing, multicomputer and multiprocessor data processing.

The specialists in computing technology should meet a variety of requirements in the field of microprocessors the specialists should have a clear idea of the capacity of their element basis, fundamentals of designing microprocessor sets and their programming support. They are supposed to be able to use this knowledge to develop and operate machinery, instruments and devices that incorporate microprocessors.

In so far as computer-aided hardware design is concerned, the specialist should know the principles of devising, functional capabilities and particular features of appropriate hardware and programming support for computer-aided designing (CAD) systems as applied to his specific professional area. He should be able to employ methods of using CAD in automatic, interactive and batch modes, arrange an exchange of data among individual facilities in the course of desig-

BEST COPY AVAILABLE

ning, and have an idea of documenting CAD and putting it in operation.

As to automatic control systems (ACS) and their particular application for controlling technological processes, the specialist should know the fundamentals of using computing technology, numerical programme control and robot-managed systems for the automation of technological processes with a view to creating flexible automatic production lines and complexes. He or she should also know algorithms of controlling basic technological processes, and be able to employ appropriate hardware and software in a defined field. With reference to production management, specialists are supposed to know which ACS hardware is used to manage the respective branch of industry and an industrial unit belonging to this branch, including automatic systems for economic data processing. He is required to devise production control algorithms on the basis of appropriate economy-oriented mathematical models of production systems.

The specialist should know the fundamentals computer-aided research (CAR) and be able to plan an experiment, control it and analyze its results. He or she is supposed to use CAR hardware in this professional area.

The orientation of specialized training as well as the actual content of instructional material are determined in function of the would-be specialist's field of learning. The instructional material can be studied either throughspecially designed subjects (such as "Microprocessors and their use for automation of various devices", "Computer-aided designing", "Fundamentals of automation of technological processes", "Planning and automation of experiments") or by incorporation into the rest of the syllabus.

Level III basic training in the use of computing technology is obligatory for all fields of study immediately concerned with the development, software provision and operation of computing technology of all classes and of sets and systems created on its basis.

Level II of basic training is required for students in certain professional fields concerned with the study of processes and phenomena that allow computer simulation, or requiring large-scale use of computers for calculation. Provision is here made primarily for fields of study concerned with electronics, electrical instrumentation, automation, machine-building, power engineering, radio and communications technology, and such university courses as Mathematics, Physics, Mechanics and Astronomy. For all these fields of study training with regard to CAD and ACS (technological processes) at engineering institutions of higher learning and CAR at universities is obligatory.

Level I is indispensable for an engineer or economist of any occupational field, and is very useful for medicine or education as well. However, for prospective doctors it is reasonable to limit studies to a description of the potential of computing technology, especially microprocessors, in medecine and to the development of elementary habits of handling medical equipment fitted with computers of different classes as their functional components. Future teachers, especially of mathematics and physics need to learn methods of algorithmization of problems and programming languages, to acquire habits of handling microcomputers, programmable calculators and other types of standard calculators, and to study methods of teaching pupils to acquire the same habits.

The engineering curriculum at agricultural educational institutions provides for a computer technology course intended to help students learn to make all sorts of calculations with the aid of microcalculators, and to use computing technology, and more specifically microprocessors, in agricultural production. As to institutions of higher learning for culture and the arts it seems sufficient for the students to get a general idea of what computers and microprocessors are capable of just to broaden their learning and eruditio

It is important to encourage students to raise the level of their training in computing technology. With this aim in view many VUZes introduce optional courses, set aside computer time for practical work, and advise students to take part in actual research, especially those portions thereof which involve computer services and

development of microprocessor sets. Training in computer technology is taken into account when undergraduates are assigned jobs upon completion of their course of studies.

Students in the fields of science, engineering and economy are trained to use computers throughout their studies.

When elaborating their curricula VUZes thoroughly analyse the content of each subject and single out those sections which contain complex computational algorithms, as well as those theories which allow the use of simulation techniques so that elements of computer-assisted calculations are introduced. There is large-scale utilization of standard-type microprocessors and microcomputers during the courses and quasi-research aimed at developing and designing various instruments and devices. There is a broadly accepted practice at VUZes of introducing new courses along with those provided for by the curriculum, at the expense of optional subjects or by including appropriate educational material in general or specialized courses.

Emphasis is currently put on systematic training of all faculty in practical use of computers, since computing and microprocessing technology is to become obligatory and constitute an essential element of professional maturity to be taken into account at periodical certifications. Faculty training is an essential part of the introduction of computer technology into the teaching-learning process. Upon completion of specialized training a faculty member is supposed to re-arrange the content of the courses he or she teaches to improve the training of would-be specialists in the field of computer technology.

These measures are designed to provide students with adequate practice in operating modern computing hardware. There is a strict provision primarily serve the interests of the educational process, and to this end an effort is made to ensure effective use of the hardware our VUZes already have at their disposal, and to introduce on an ever larger scale mini- and microcomputers and programmable microcalculators in the educational process. It is important to emphasize that more efficient use of computers can be achieved

large-scale multiple programming, setting up a multiple access system, long-term planning of computing activity to take account of an uneven load of students' computing requirements for the VUZ's computing centre, a strict recording of computer time, using promising programming aids, and carrying out a series of measures that are aimed at establishing the best possible organizational and technical operating conditions for the computing facilities.

Experience has shown that the use of microprocessors in various installations, models and instruments, both as an object of study and as a research tool for laboratory and practical work and papers and projects, is of importance for students to achieve mastery of this technology.

A more intensive use of the conversational mode by the students and teachers in dealing with the computer is another way to improve the organizational forms of employing computers in the educational process. In this mode, a comparatively small increase in computer time leads to a considerable reduction in the cycle wherein students prepare and debug programmes with a corresponding cut in to execute problems. The study of programming languages and of the fundamental of computer hardware is enhanced if it is supported by computer-aide instruction (CAI) facilities.

The computer appeared in the classrooms of Soviet VUZes within the traditonal forms of academic activity: in seminars to consolidat the lecture material by solving problems and doing exercises, for calculations to prepare course papers and graduation projects, durin laboratory practice. For example, a student's laboratory work can consist in simulating various processes, conducting research work, doing some training or consolidating practice. The individual teach ing functions include, for example the important one of control over the progress of learning.

The application of the computer at VUZes has gradually led to the appearance of new forms of academic activity thanks mainly to the possibilities offered to faculty and students through additional services inherent in mechanization and automation of management at all levels of the VUZ's structure, planning the educational process, and so on. Such activities will grow and (in quality) VUZes are

being supplied with more and increasingly sophisticated. Some progress remains to be made in overcoming resistance to innovation.

The computers are employed in the Soviet VUZes to serve the following purposes:

- assess the students' knowledge and to manage element the educational process;
- solve problems, make calculations and do exercises;
- simulation and laboratory work;
- to carry out research and design work;
- to plan the educational process;
- to organize and manage education

Assessment is a diagnostic procedure aimed at evaluating the extent to which the students master knowledge, skills and habits. In the course of assessment the student may receive new correct information. Assessment therefore also carries out certain teaching functions. Traditional forms of assessment are extremely time-consuming and do not as a rule offer the teacher an opportunity for creative effort, a fact which in effect slows down the process of perfecting the evaluation procedures. The computer can be used for assessment of all kinds - preliminary, current, intermediate (upon completion of a section of a course) and final. With the computer the process of assessment is largely individualized. The student and his teacher can obtain the results of assessment without delay and feed in correct information. The computer can conveniently for teachers provide a list of the group showing an analysis of the results, a unique opportunity. The computer can accumulate data covering the student's entire educational record at VUZ. The teache can analyse these data to obtain objective information about the process of the student's intellectual development to get a clearer idea of his or her professional orientation, ascertain his knack for self-education and capacity for an effective use of additional information sources.

The use of the computer makes it possible for assessment programmes to be exchanged between VUZes. This possibility makes for standardization of requirements and in the final analysis will result in a higher standard of education. The computer surpasses the autonomous assessment aids in that it provides for more varied answers fro

the students, allows for changes in content, and makes it possible to collect statistics and process data.

Much use can be derived from the computer for entrance examinations. An experiment in using computers for entrance examinations has been conducted in Soviet VUZes since 1980. The results of the experiment so far make it possible to arrive at some conclusions:

- a uniform assessment of the applicants' knowledge is ensured, and chances of bias on the part of the examiners are reduced;
- punctaluaty is ensured in conducting the examination: any number of applicants can take the examination on the same day. The examination commission can receive the results on the following day;
- personnel detached to sit on the examination commission can be reduced;
- necessary statistics to shape the profile of the applicants and the results of each examination can be readily obtained.

The computer can be used to assess written tests in mathematics, physics and chemistry, from individual assignments in the Russian language and literature, fix a procedure to assign classrooms and seats to the examinees, and hand out assignments in all subjects.

In view of the fact that the computer is being used as a tool for entrance examinations on an experimental basis each of the experimenting higher educational establishments is supposed to make an independent decision as to the scale of its participation in the experiment with due account of the experience it has gained in using the computer in the teaching-learning process. It is advised in this connection that tests and final examinations at preparatory departments should be used to finalize all organizational, methodological and programming procedures required for computer-based entrance examinations.

The development of a stock of examination material and the composition of individual assignments is an important factor which influences the quality of computer-managed entrance examinations. It is recommended that each problem, example or query included in the stock should have a certificate which will indicate, in addition to the proposition and solution (answer), an acceptable length of time for the solution (as assessed by the composer) and the degree of complexity of the problem.

In the initial stages the teaching load for the faculty of the departments involved goes up; it is therefore stipulated that this type of activity should be provided for in the faculty's individual plans.

An expert faculty member is designated to prepare written examination tests in each subject. The expert, who is supposed to know the particular features of the various fields of study at the respective VUZ and who knows well how the subject concerned is taught at secondary school and at secondary specialized educational establishments, sees to it that written tests are in compliance with the entrance examinations program. It is his duty to check experimentally the problems, examples and queries for the degree of complexity, and establish that there can be only one correct solution for each problem. He is also required to ascertain the maximum possible time to be allowed for each assignment, devise individual examination assignments, packages and series, and see to it that the packages of individual examination assignments are kept secret.

It is presumed that individual examination assignments should make provision for the knowledge of subjects to be assessed by elementary components of each section of the program concerned, so that the number of problems (examples) and questions in each assignment would correspond to that of the main sections of the Entrance Examinations Programme for each subject, to be annually approved by the Ministry of Higher and Secondary Specialized Education.

For the first examination in mathematics, which is intended to assess theoretical knowledge and practical habits in all sections of the programme, it is recommended that an assignment should include 16 to 20 problems (examples) and 2 to 3 theoretical questions. For the second examination there should be 5 to 6 problems of a more involved character.

It is recommended that the physics examination given in written form and last 180 to 240 minutes - just as much time as is suggested for the mathematics examination. An assignment may include 10 problems and questions concerning all sections of the programme, to be supplemented with 2 to 3 problems or questions from sections particularly important for the specific educational establishment.

Computer-aided examinations in chemistry have been practised by a limited number of VUZes so far, but the experience has shown that the computer promises efficiency for entrance examinations in any subject.

The following general requirements should be complied with when designing individual examination assignments in any subject:

- every problem or question incorporated in examination assignments should be in strict compliance with the Entrance Examinations Program;
- all versions of an examination assignment within a common package should have an identical structure and be of equal difficulty;
- problems (examples) and questions in any assignment should be clear-out, precise, and completely unambiguous;
- all problems and questions should be checked for adequate wording. Work should be undertaken to correct the stock of assignments upon completion of entrance examinations, with a view to improving it for the next year.

The work load of faculty members during examinations is reduced because the examination in a given subject is given to all examenees on the same days and the results are processed on the computer.

Once the examinees' answers and the punched cards bearing standard answers are in the computer, the Admissions Commission can obtain an integrated list of applicant arranged by the number of problems (examples) solved correctly. The Chairman of the Admissions Commission and the members of the Examinations Commission can then decide on criteria of assessment for the entire stream of applicants. The overall result of the examination in a subject largely depends on the quality of the stock of assignments and also on whether the right package and series have been chosen for a particular stream of students. When establishing the boundaries of assessment grades care should be taken to ensure that grade 5* is awarded for 95 to 100 per cent of properly solved problems (examples) and correct answers, grade 4 for 75 to 94 per cent, and grade 3 for 50 to 74 per cent. Tests for which all grades fit in between 2 and 3, 3 and 4, 4 and 5 removed from the batch and go for assessment in the traditional manner.

The computerized method of assessment inevitably calls for rigid formalization and makes it difficult to take into account of appliants' non-formal peculiarities, such as ability to think logically, carelessness or nearness. This increases the responsibility of the Admissions Commission concerning appeals.

The seat and timetable of the Commission of Appeals should be made known to all applicants on the days of the entrance examinations. It is recommended that applicants should be given a chance to know the correct answers before the Commission of Appeals goes into session, as this measure results in a smaller number of appeals that can be submitted by applicants.

Considering the new conditions in which entrance examinations are conducted the rectors of the institutions of higher learning that participate in the experiment are advised not change the composition of technical personnel attached to the Admissions Commissions.

---

* In the Soviet educational system the scale of grades runs from 5 which stands for superior achievement to grade 2 which indicates failure, with grades 3 and 4 marking graduations between.

The use of computer technology at entrance examinations calls for much more efficient functioning of the Admissions Commission staff and brings one more element of the VUZ's structure into the picture - its computing centre. The computing centre personnel carries a heavy responsibility for keeping the hardware in an impeccable condition; they must have perfect mastery of the appropriate hardware and be meticulous in inputting the required data within the rigid time limits.

The promising results of the experiment suggest a possibility of a broader application of the experience gained in the use of the computer at entrance examinations at VUZes.

Computer-based assessment systems are being developed at many Soviet VUZes. The software of such systems includes answer analysis subprogramme for preliminary processing of answers, syntactic and semantic assessment, diagnosis of sources of error, and decision-making. The main advantages of computer-based assessment can be summarized as follows: it is an individualized, unbiased and economically sound like of assessment which makes it possible to handle promptly and simultaneously as many applicants as necessary

Yet despite the fact that it is important and indispensable, assessment is but an auxiliary or, to be more exact, and result of the educational process. It is presentation of new instructional material to the students that constitutes the basic element of instruction. This process calls for a creative effort and it cannot therefore be fully relegated to technical aids, including the computer. These aids, however sophisticated, are in the final analysis mere tools in the teachers' hands, that help to ensure interaction between teacher and learner in the integrated teaching-learning process.

Consequently we believe it is improper to suggest, as is unfortunately often the case in pedagogical publications, that the teacher should be replaced or that, for example, the lecture as a form of instruction should be eliminated from instructional practice. The lecture holds a leading place in the educational process - it is the form of educational activity which serves not only to communicate new knowledge to students but also to shape their scient

BEST COPY AVAILABLE

ific outlook. The lecturer guides the learning process by revealing the logical structure of educational information and its theoretical and practical significance, and he encourages the learners' own cognitive activity; the lecture is also a form of common learning activity for many students. Traditional lectures have naturally certain shortcomings, such as the predominance of communication over retention or orientation for average students, or the lack of immediate objective information on the students' mastery of instructional mastery of instructional material one can also add that some faculty members are inclined to turn lectures into dictation.

However, it has now become accepted practice to equip lecture halls with monitoring feedback equipment and to rely on computers to process statistics. The faculty have had ample evidence to prove that with instructional material being presented through a lecture, the computer can control a technical aids compound, including audio-visual aids to present information, and computerized statistics. These are now referred to as teaching monitoring units (TMU).

The television-based teaching/monitoring unit PHOTON-5 developed at the Tchelyabinsk Polytechnical Institute can serve as an example of how various audiovisual aids can be employed not only to bring forth new knowledge but also to assess retention. The main purpose of the PHOTON-5 unit is to ensure an active involvement of the students at lectures. This purpose is served by:

- immediate feedback through an ELECTRONICA-D3-28 microcomputer, a suitable terminal and videomonitoring devices;
- integrated use of audiovisual aids, such as films, slides, videorecordings.

The unit makes it possible for the teacher to switch on the right source of information at the right time, put questions to the students on the material presented in the lecture, and ascertain the level of retention.

Before questioning, the students put in their passwords to identify themselves as being present. When questioned the student is to give an answer within the allotted time. The numbers of the answers chosen and the results are shown on the screens of the students' video monitors.

The feedback terminal serves to supply information about the learning activity of each student and of the entire group. The lecturer will use such information to correct his presentation if necessary. The PHOTON-5 unit can provide for the teacher to run a class of 225 students.

The Tchelyabinsk Polytechnical Institute (TPI) is now actively engaged in developing technical aids that would be compatible in terms of programming and designed on a modular structure principle. A television-based teaching/monitoring unit names PHOTON-6 has been created at TPI with this aim in view. This unit can serve as a technical basis for conducting various instructional activities such as lectures, practicals, tests, tutorials, students' independent work. It makes it possible for the teacher to approach each student individually. Since such an approach requires an objectives analysis of each learner's individual abilities, which, in turn, calls for readily available and detailed information about current achievement, a sufficient number of versions of test assignments have been designed, and provision has been made for storage and processing of continuous assessment results obtained in reference to prescribed programmes.

The PHOTON-6 unit resolves itself into a number of components which include an instructional television set, a monitoring feedback circuit based on a microcomputer, type ELECTRONICA-60M, fitted with an information input-output device, and service appliances. The unit is capable of handling up to 50 students at a time.

The unit software makes it possible for the teacher to select such methods and techniques as he thinks most efficient for a given group of learners, and decide on a rational load for each learner. The programme also provides for extra classes to be given to some

students to deal with specific sections of the course under study, and for assignments of no-ordinary difficulty or of a research character to be served to learners.

Further expansion of the microcomputer memory will expand the teaching resources of the unit and provide for individual recommendations to students as to how to deal with gaps in their knowledge stemming from previous courses, foresee assimilation by a specific group of new instructional material before it is taught, evaluate students' individual preferences and choose research assignments for students to suit their interests and capabilities.

As terminal hardware is further developed to reach an appropriate level, other methods of computer-assisted presentation of information will be devised to enrich the lecture. Ideas to be considered include coupling the computer as a controlling component to a closed circuit television system, and using the computer for creating animation. Systems incorporating television receivers as student's terminals are now widely used in Soviet institutions of higher learning as part of computer-managed instruction.

The terminal equipment of the computer-managed television based instruction system (ATOC) devised at Byelorussian University in Minsk is an inviting venture. With the aid of this terminal device, in which a TV receiver, type YUNOST 402/405, is used, a student can interact on line with the computer, with customary forms and methods of information recording being maintained.

The ATOC terminal can be coupled with an instruction television circuit and a computer of the EC series. It may therefore be regarded as an all-purpose instructional aid encompassing both the rich expressive capacity of television and the powerful computing potential of modern computers.

We suggested earlier in this paper that the instructional resources of new technologies resolved themselves into three main functions:

(a) creating favourable (optimal) conditions for teaching and learning;

(b) providing the teacher with an efficient tool for managing the learning process;

(c) serving as a vehicle of implementing the curriculum content.

Although we could consider these points in detail, the scope of this paper does not allow it. We shall, therefore discuss the first function at length and make just a few remarks with regard to the other two.

The ability of modern media to create favorable conditions or, even, optimize, teaching-learning activity is twofold:

- improving objective (or external - in reference to individual subjects) conditions - informational, methodological, organizational and hygienic;
- creating favourable subjective (or internal) conditions conducive to the student's involvement and a rational management of his learning activity.

Being by origin external in reference to the individual subject of learning activity the objective conditions are reflected and interpreted in his psychics, and for this reason acquire significance from the point of view of psychology and pedagogy. It is clear that the external (subjective) factors of learning activity are brought about and maintained not only owing to those favourable external conditions which modern media introduce in the instructional process. It should also be underscored that relation between the former and the latter is not at all obvious - experience proves that with an incompetent use of the potentialities of media individual external improvements, such as a variety of information sources, comfortable conditions and the like, will not influence the student's cognitive activity appreciably.

Let us remember that when using media the teacher disposes only of "external" means of fostering the student's interest in instructional material and influencing his activity. Yet external causes can only be operative through internal conditions, and lack of positive motivation for learning cannot be compensated for by such a particular factor as the use of modern media.

Motives for cognitive activity do not emerge from media-fed information. One must take fully into account the overall psychological situation the instructional set-up, and make sure that there exists a dominant motive in the student's cognitive activity that can permit him or her to profit from the instructional resources of modern media.

The closes connection between external and internal conditions of the tea hing-learning activity, which can only be distinguished by means of a scientific analysis justifies our approach whereby the exa ples given below, of how modern media are used, are correlated or convenience with two categories of favourable conditions for eaching-learning, of which one is proposed to be named (just for convenience too) methodico-organizational, and the other - psycho- edagogical.

Audio-visu l media is served for the visual presentation of abstractions. hey go a long way to enrich and compress instructional informati n in a dynamic way and visual cues serve to facilitate abstract th nking and oral communication.

Instructio al information portrayed on the screen acquires an easily perce vable structure is instructional material is divided into logical el ments (blocks) as reflected in graphical diagrams and in the edit ng pattern of a visual message.

Our experi nce proves that vision mixing techniques, for example, can ha e a specific meaning and serve as a means of structuring screened nstructional material rather than merely adorning the presentatio . They make it easier to transform drawings and mathematical ex pressions, compare objects to be studied, emphasize significant ele ents, demonstrate relation between elements of a symbolic model, and they can show how symbol and reality belong to each other and c rry out a number of similar operations.

A simple v sion mixing unit makes it possible to split the screen vertical y or horizontally, to ensure a visual comparison of various chara teristics of electrical circuits modulated by

oscill-ograms. Vision mixing, combined with graphics designing techniques, can often replace expensive and time-consuming animation while producing a nearly equal visual impression.

It should be stressed that animation photographically or computer produced can be regarded as a unique symbolic system. It helps the learner to penetrate the essence of the phenomena and processes to be studies. There are topics which require animation as support. To quote only one example, one cannot present an adequate picture of an electrical field and distribution of charges in any other way. Animated cartoons find large-scale uses in subjects such as chemistry, physics, theoretical mechanics, higher mathematics, and descriptive geometry.

In a broader sense the term "picture" incorporates a peculiar state of the screen, which is arrived at by means of electronic (computerized) modelling without recourse to an optical device. Graphics of functions and diagrams, oscillograms of electromagnetic and mechanical oscillations and many other electronics models prove to be extremely efficient for studying physics, mathematics, general and specialized engineering disciplines. The use of computers permits the setting up of a software bank to be drawn on for visual material for screened messages.

One would do well to remember that an essential element of mathematical education is learning to read graphics. There is plenty of evidence to prove that students often cannot read graphics reveal a total lack of understanding of the very content of graphics and make errors in deciphering values to be derived from them. One can easily devise a programme aimed at teaching students to read graphics. A possible assignment in such a programme would consist of a visual transformation of a row of values of monodimentional quantities, obtained through multiples measurement, into a two-dimentional graphical diagram, with values corresponding to appropriate time intervals being marked along one co-ordinate axis, and values to be taken along the other axis. Let us say that the display screen shows a thermometer indicating specific values of the temperature of a patient at half-hour intervals. The image of the thermometer will gradually shift along the time axis, with the top of the thermometer mercury drawing a graphics line.

Closely connected to the use of computers for graphics reckoning and problem solving is the mode of modelling, which is one of the most popular methods of computer-aided instruction (CAI). The modelling systems have come to be known as CAMB (Computer Aided Model Building), and they can be regarded as a particular applications of CAI systems. The modelling mode is primarily an inductive method of instruction and serves to create visual images of complex phenomena.

Perfecting methodology is important in improving the conditions in which teaching-learning takes place. Audio-visual media make it possible for the learner to penetrate in the essence of processes and phenomena to be studies, and facilitate access to objects that do not yield to observation with the help of any other means.

Audio-visual media enable the learner to observe the action and application of various equipment instruments of so large a scale, that only a videorecording can enable a view of the true dimensions or complexity. With the aid of AV media, one can observe objects and happenings in a broad range of scale - the camera can zoom in and out to show detail and relate to context. Thus we can project on the screen a general view of a launching site while a rocket is being launched, and a close-up of a chemical reaction.

Audio-visual media make it possible for the learner to see, simultaneously working mechanisms, instruments recording their parameters and changes in the parameters brought about by switching from one mode of operation to another. By using juxtaposition techniques, one can show the key circuit diagram of an instrument and the instrument itself, an electrical circuit to be tuned and its frequency characteristic, a microobject and a vernier scale to take its measurements.

Modern media facilitate an organic association of theory and practice - by having, for example, a lecture include a demonstration of a practical activity in related spheres. This relationship fosters students' interest in studying applied subject.

The dynamics of transient processes is not accessible to the human eye in ordinary conditions. Recording processes on film by rapid shooting permits us to investigate, for example, the movement of a flying insect's wings in a zoology course. Preliminary frame-to-frame filming on the other hand, enables the analysis of very slow processes, such as the growth of crystals.

A videorecording camera can make educational material acquire dynamical parameters by bringing into play such techniques as panning, zooming in and out, by combining the effects of panning and zooming.

Audio-visual media are capable, for all intents and purposes, of taking the learner to any place, of putting him in any situation. This communicative possibility is extremely important in studying foreign languages or specialized disciplines that require learner to develop a capacity to make decisions in critical situations, for staging business games, dramatizing problem situations, setting problem-oriented cognitive tasks and similar assignments.

The combined efforts of engineers and scientists have recently led to the development of perfect television-based microscopes that permit the observation of microscopic objects. Television-based microscopy is successfully used both in research and in teaching. The introduction of a television-based microscope, created by coupling a TV camera to a microscope, has brought about appreciable additional instructional resources in teaching, for example crystallography or mineragoly. It is now possible to show the entire audience typical microstructures and physical features of crystals, involve all students in active work to diagnose crystals, and manage the process of learning microstructures. Showing microstructures and measurement scales enlarged on television screens makes it possible for students to take sufficiently accurate measurements even when they work in large groups.

These aspects must be developed in conjunction with an optimum organization of the use of media.

The use of modern media fits organically into recent theories of education. Accepting the idea of learners' active involvement in instruction means operating a transition from predominantly information delivering methods of instruction to patterns of activity aimed at developing creativity, encouraging mastery of the methods and technique of professional activity, and forging new personal and professional traits. Such a transition is coherent with contemporary societal requirements for high-level with increased creative potential.

Ensuring learners' active involvement in the instructional from and professional training can only be brought about by extensive individualization of instruction.

The modern media can be used to individualize instruction in several ways:

- the teacher can devise instructional material and record it on video for subsequent repeated use by students, thereby releasing part of his teaching load time to attend to students individually;

- a student can play back the video-recorded material to reach a good mastery of the prescribed instructional material, and in so doing can rely on the technical possibilities the videorecording technology offers (re-winding, slow motion, still pictures, etc.);

- the teacher can develop differentiated didactic material intended to cater for students with different intellectual interests, to be realized in the CAI mode or through videorecording.

One should not forget the individualized approach is not boundless in its potential application. Yet experience with the use of new technologies for individualized tutoring shows that it is quite possible to take into account differences in precollege preparation, that the students have greater freedom for planning their own work and that there appears to be a real possibility of catering to students individual interests and inclinations.

For correspondence (distant) education, new technologies, such as satellite television, introduce an element or organization in the studies of those who take their courses without leaving their jobs. They do so by reaching scattered and outlying groups of students in areas which because of their largely rural character present problems of communication. Distant learning in such areas is carried out mainly through print. New technologies change the situation: a college comes to a student's home instead of the student going to the college. An apportunity for a learner to arrange for his studies at home is difficult to overestimate.

If one chooses to compare print, film, and broadcast television, one cannot fail to come to the conclusion that print and film deliver information to the learner in a substantially depersonalized form, while broadcast television provides for teacher and student to be in contact, though, to be sure, such a contact is indirect and unidirectional. The television lecturer personifies for the learner not only the course production team but also the relations of the social groups involved in the process of education. This is hardly of value for an on-campus student who is in permanent contact with faculty, but it may exercise a very substantial didactic and educational influence a distant learner.

Mention should also be made of the role of the modern media in creating favourable organizational conditions from the point of view of physiology, hygiene, and safety.

In the past, strong doubts have been voiced concerning audio-visual media on the basis of the belief that the use of such media would necessarily result in serious fatigue for learners. Experience proves that this fatigue does not exceed the level typical of college instructional activities in general, provided the media are correctly employed - both pedagogically and methodologically.

Better conditions of observation and the elimination of the exertion and resulting fatigue of eyesight from prolonged microscopy are quoted as obvious advantages of television-based microscopy.

Television finds a large-scale application in the teaching of disciplines which in other conditions present a danger to the health of learners. Television-based microscopy makes it possible for the teacher to carry out in laboratory work, without fear of infection, experiments with any pathogenic bacteria. Instructional television is often used for demonstrations related to general chemistry, especially when chemical processes are accompanied with the formation of noxious combinations. The use of television coupled with an X-ray device reduces to a large extent the dose of radiation medical students get during roentgenoscopy.

In principle, the learner's active involvement in instruction and his activeness in social and professional self-determination and development is regarded as a fundamental principle of higher education. The student is encouraged to be active in the course of instruction with a variety of didactic techniques, including problem-oriented presentations of instructional materials.

However, any external impetus, can only be effective if there are also internal psychical conditions contributing learnings. Educational psychology quotes motives, interests, and emotions among such conditions, or psychological determinants of activity.

Psychologists maintain that motives, goals and purpose play the role of the most important system-forming factors in Man's conscious activity. Thus the quality of instruction depends to a large extent on whether or not there is positive motivations without such involvement a student will not take part in a lesson - he will be just present.

The motives we are discussing here are specific energizing agents for specific cognitive tasks, rather than global stimuli for getting a higher education.

The audio-visual media's role in motivation can be wide indeed. To begin with, the inherent properties of the audio-visual media, which media-based activity methods rest upon, serve as a basis for cognitive motivation. An opportunity for a learner to see and hear life in its natural course and development, sense the harmony of forms, witness major occurences, view an event from different vantage points, and from close up, observe unique scientific and technological experiments as well as natural processes barred to human eyesight in ordinary conditions - these and many other possibilities of the AV media serve as a strong and steady motivation and make for active perception, comprehension and retention of instructional material. The audio-visual media, can make clear relationship between the curriculum content and real life.

Motivation is provided for, in a large measure, by transition from the state of lacking knowledge to that of knowing; the realization of the fact that much of what the student has learnt can only be learnt with the aid of AV media is an obvious stimulus for media-based instruction. In other words, the motivational influence of the audio-visual media is reinforced thanks to the striking disharmony between audio-visual information and the ideas the learner has of objects being studies (the so-called cognitive dissonance).

Associating the learner to real scientific problems, which bear on phenemena that have not yet been definitively studied, is a form of stimulating learning activity. In contrast to research, the instructional process aims at reproducing the pattern of research activity rather than the eventual result of a search. This circumstance is of special interest within the context of this paper since contemporary science makes wide use of indirect observation of experiments and of recording their results with television,film and photography as well as computer graphics. When such materials (situations) are included in audio-visual instructional messages the messages are understood in what may be called a real act of scientific cognition, since the student discusses with the researchers possible hypotheses and versions, methods of solution, and as a result obtains new knowledge, and an answer to a problem as if he had really solved it by pooling his efforts with those of the people engaged in this problem in science or technology. Thus we can name one more motivational function of the audio-visual media - that of creating real research situations.

The formation of productive mental processes takes a prominent place in the development of cognition. We call production those processes, which provide for a subjective discovery of something new (something unknown), accompanied by the engendering of new mental formations. In the course of his meditating

behaviour Man independently continuously new properties of objects and relations between them, and furthers the internal conditions of his thinking. A problem situation is a general condition which stimulates productive processes.

The learner's emotional state contributes to the subjective (internal) conditions of learning. Soviet psychologists' feel that emotional stress makes part of the adaptation complex as Man's accomodation reaction in relation to the environment.

Man's mental activity in the course of cognition includes not only the intellect sphere but also emotions and will-power. The theory of education regards cognitive activity as a unity of intellectual, emotional, volitional and other components which constitute the structure of this activity.

Research reveals that althoughaudio-visual material prepared for presentation should not contain pedagogically irrelevant outward adornments which destroy the rational structure of the message, a motivationally oriented message may be enriched with attractive and entertaining elements to foster, among other things, the aesthetic education of the students. This is coherent with the holdings of contemporary psychology and didactics that the student's emotional and volitional sphere, when energized, multiplies his cognitive resources.

The fact that the screen strengthens motivation for learning and arouses interest in mastering curriculum content largely thanks to the functioning of the learner's emotional and volitional sphere leads some researchers to believe that television instruction is important not only for the mastery of instructional material but also for the formation of the student's moral qualities.

So much for the favourable conditions in which teaching-learning takes place. Let us now turn to the problem of managing the learning process.

The idea of managing Man's cognitive activity in order to achieve the educational goals of the teaching-learning process is inseparable from that of active involvement on the part of the learner himself. The efficiency of the student's learning depends not only on perfectioning the management of learning but also on the individual's system of motives, goals and cognitive needs, and the level of self-control over learning has which he or she has reached.

Certain contemporary psychological theories overtly or convertly proceed from the assumption that thinking can be reduced to solving ready-made, teacher-formulated problems while the intellectual process of solving such problems can and must be determined only in reference to the "eventual situation", or the "eventual state of thinking". Advocates of this approach put forward the cybernetics-based universalism of feedback as a chief principle that provides for managing Man's cognitive activity in an optimal way.

On the other hand, ever more followers are adhering to a concept of learning management, which does not consider it absolutely necessary to include a feedback loop in the management circuit. Such an approach proceeds from the proposition that Man's thinking, which plays a leading role in revealing and mastering the unknown, is his principal instrument of learning. In terms of learning activity the unknown resolves itself into knowledge, techniques and conditions of acting or problem solving, which the learner is supposed to assimilate but which are not assigned to him from the outset in the shape of a model of result.

The productivity of this approach from the point of view of active teaching methods is obvious. This approach turns out to be especially valuable in the context of this paper since the lack of feedback is usually quoted as a substantial drawback inherent in the audio-visual media.

We should like to make it clear that media-based management of learning activity is discussed here in a narrow sense, as a system of calculated didactic influences on the learners' mechanisms of cognitive activity limited to their immediate efforts to apprehend and assimilate instructional information, as a system of interrelated operations the purpose of which consists in shaping and directing the students' cognitive activity and maintaining their mental functions at an optimal level of activity. Such important questions of management as determining the strategy of education of setting long-term cognitive tasks in the field of instructions and research, are outside the scope of this paper bacause their solution does not have direct bearing on the application of instructional media.

The management of the cognitive process is based on the laws that underlie it, and consists mainly in setting up optimal didactic conditions that may lead to a situation where the learner would be fully involved in the teaching-learning process and their cognitive resources would be alerted to solving the assigned instructional task. Apart from the common set of control incentives that any teacher resorts to irrespective of media he chooses to use in a specific learning situation, the audio-visual media offer the teacher specific possibilities of managing.

Management of media-based instruction takes on two main forms: (a) contextual management, which relies upon editing techniques, cue stimuli and operation models, and (b) auxiliary management, which is carried out with visual, oral and visual-oral indicators.

Let us analyze the management forms as applied to instructional television. Our choice is governed by the fact that instructional television represents the AVM group since its language is the richest and in fact it incorporates the elements of the expressive resources of all the media of this group.

The resources of the television language can be used to direct learning activity. The combined effect of these resources results in an emphasis on the scientific information and creates optimal conditions for its perception from the point of view of psychophysiology, with due account of the requirements of aesthetics.

The TV language techniques can be divided into what may be called intrasequence techniques which ensure interpretation of information contained in a continuous sequence (sequence composition), and intersequence techniques which are used to control perception at the level of episodes and messages as a whole (sequence editing).

The techniques of shooting include choice of angles of view for the camera, type of optics, light and colour solution as well as different combinations thereof.

When selecting an angle of view, one should bear in mind that the learner always regards the television screen in its entirety, and the television image comes across to him or her as a completed picture.

A close-shot in television has two roles to play: firstly, it serves to emphasize key features, ensure a culmination of composition, and secondly, it is employed as a means of direct contact with learners. It may be claimed that a close-shot helps to guide the teaching-learning process: it makes it possible to dwell on a particular activity or subject to isolate its significance and exclude distractions.

The mobility of the camera, its movement to change angles of view serves to command the learners' attention and create the best possible conditions for visual perception.

Along with its internal (logical) structure an instructional message has an active external (perceptional) structure. With the aid of editing which happens to be a most important component of TV's expressive resources and resolves itself into various techniques of coupling individual sequences to produce complete messages a consistent presentation of instructional material is ensured, and so is a dynamical unfolding of screened "events". It will be

remembered that editing is not a mechanical fastening of sequences to one another, it is a process whereby a logically harmonious and rhythmically balanced flow of instructional information is produced. One may call editing the syntax of TV production.

The editing-based structure of an instructional televised message calls for editing variety for at least two reasons. In the first place, one single camera shot cannot squeeze in anything from a close-up to a context view and, at times, it is quite impossible to show an object as a whole. Editing makes it possible for the production team to cut from one camera to another to supply pictures taken at different viewing angles, to produce a more adequate image of the object to be presented. In the second place, variety introduced by changing viewing angles reasonably helps to sustain the viewers' attention and, hence, perception.

Television technology has widened the range of editing techniques to include what is called vision mixing. Among different techniques of this kind one can mention superimposition. Showing several images coming from two or more cameras on the screen is not a very complicate technology - images are imposed one upon another by means of a simple manipulation on the control panel. The levels of the control panel can be used to make the intensity of the ingradients of the combined picture stronger or weaker. By blending one camera's picture with another's to show how symbol and reality belong to each other or how the outline of an object and the object itself correspond, or by superimposing a caption, an animation device, or a plane view on anything another camera shows, we can control the learners' mental functions.

Another editing technique is to bring two or more pictures to the screen without blending them. To do this the screen image is split vertically or horizontally so that pictures arriving from different cameras show on the left and on the right, or on the top and at the bottom of the screen.

Visual and verbal cues are of important to establish the causality of events unfolding on the screen and, consequently, to manage concept formation. A visual cue is taken here to mean a form of visual imagery - such as a visual fragment of a situation or a graphic

BEST COPY AVAILABLE

representation of relations among objects, or people and objects, of just people - which helps the learner to correlate language symbols to nonverbal reality and thus facilitate the process of thinking. A verbal cue, intended to perform the same function as a visual cue, in practice takes on a form of a specific aural sensation.

Cues are especially valuable for language study. Visual cues help the learner to establish a correlation between language patterns to be learnt and events shown on the screen. It will be remembered that most components in a situation which make speech comprehensible are visual in character. Whatever stays or appears in the frame or leaves it - both animate and nonanimate objects - is a potential visual cue: participants of the dialogue, their clothing, the set, all movements of the cast. The moment a participant of a situation shown on the screen begins to speak a foreign language whatever is revealed to the learner's eye becomes a visual cue, with those visual components of the situation assuming a particular significance which directly ensure that a given language pattern acquires its true meaning. A superimposed caption containing the written image of a key language pattern can also serve as a visual cue.

As to listening imagery its value is difficult to overstate since it helps the learner to form aural sensations and notions and thus contributes to the creation of audio-motor images.

All sorts of signals that accentuate and emphasize different elements of an audio-visual message and, in this way, control learning can be used as cues. Various vision mixing effects and graphic techniques can serve as such signals.

We mentioned earlier in the paper that operational models make part of the cognition controlling resources of the AV media. An audio-visual message is regarded, for the purposes of this paper, as a specific model of an object to be studied. The modelling function of the audio-visual media covers not only objects but also methods and situations. Professionally significant object-managing, symbol-handling and vocal-motor actions and operations can be modelled in different ways: various types

of simulatios can be employed, techniques and procedures of staging eperiments or procedures of assembling experimental devices and instruments can be shown, sequence of forthcoming ork operations in the course of developing professional skills and habits can be brought to the learner's attention, aticulation of sounds of foreign languages with a view to helpng the learner to master the required level of pronunciatio can be demonstrated.

Auxiliay management includes visual, oral and visual-oral indicatcs. Separate musical phrases assigned, for examples, to typial instructional activities or signals of the gong setting a time limit to the fulfilment of assigned instructional tasks can serve as management indicators. These can be accompagnid by written cues in work-books or passouts.

Numerous applications have been found of visual cue indicators in the form of animations and captions, the latter being fed to he screen either by superimposition or otherwise. It is possibl to duplicate sound signals with visual ones. Sometimes spelialized training calls for an accent on the development of one o several mental functions. It is quite possible in such cases to take account of a specific educational goal and conditios of the teaching-learning process, and lay emphasis on guidig perception, attention, retention and at the same time maintain the mechanism of active involvment in a workable state. We could think of such specific educational goals as an accentuated dvelopment of, let us say, immediate retention (a language interpreter), colour perception (an artist), spatial thinking (a designer, an architect) etc. And though the leading function is suported and provided for in such cases by all the others the ful "charge" of managing incentives will necessarily include speciic impulses directed at the development of professional retentio, professional perception or professional thinking.

The teachr can rely upon television to manage the most important mentl functions of the learners' intellectual sphere (perception, atention, retention) as well as the activity of their emotiona and volitional sphere.

In education each subject of study comprises a system of concepts which reflect the state of the associated branch of science, and the assimilation of concept is the nucleus of the teaching-learning process. An important part of formation of concepts and notions is actual perception of new knowledge - it is here that the instruction begins.

Instructional television can make the greatest contribution to learning at the perception stage: it can enrich the learner's conscience with new notions about the objective world and help him to form the required concepts.

Both in life and in learning, man perceives an object at first in its entirety, in his external connections and relations with other objects. An active process, perception is characterized by directiveness and selectivity. To begin with, television helps to boost the selectivity of perception by highlighting those features of an object that are of importance to learning, although they may not be overt.

A rational presentation of information is crucial to learning On television spoken communication is flexible and concise - brief in form but comprehensive in scope. The spoken word has a partner a visible image which takes upon itself part of the information load, and makes the word more comprehensive and significant.

By alternating a visual and an oral dominance avoid placing stress on the learner.

Television strengthen the visual element of instruction; it also synthesizes images and sound to create an audio-visual compound which enhances learning.

The teacher's skill in guiding the attention of learners is of paramount importance. Attention plays a significant role in any human activity, especially in learning. The great Russian educationist K.D. Ushinsky used to say while stressing the importance of attention that it is the door through which passes all tha enters Man's soul from the outer world.

BEST COPY AVAILABLE

Television offers the teacher a real opportunity to guide attention. TV's expressive resources, such as zooming and pannin techniques make it possible for the TV camera to zoom in on a significant detail of an object being studied, which is essential for concept formation. The capacity of television to isolate and focus on the essential goes a long way to suppressing the phenomenon of a strong component masking a weak one in a complex stimulus. Such television techniques as sequence-to-sequence editing, changing a camera's viewing angles, superimposition, and similar techniques, serve to set up optimal conditions for viewing a televised picture and sustain the learners' attention at a productive level.

Learning is the highest form of retention. Television possesses ample resources to stimulate active retention and reproduction of information.

So far we have been discussed the possibilities of televisio for intellectual stimulus, but it appears that the emotional and volitional spheres can also be influenced. Emotions stimulate mental functions and emotional manifestations themselves can be o managed with a view both to control and stimulus.

It is psychologically essential that the information perceived on the screen be a direct reflection of a phenomenon, a process or an event rather than information about a phenomenon, a process or an event. This means that the viewer must be involved in what is going on on the screen. Authenticity and reality are keys to conviction top images.

We now come to how AB media can help the teacher to implement the curriculum content. The term "curriculum content" as used in this paper implies not only the system of knowledge, skills and habits which the students are supposed to master in the course of education, but also certain other aspects of education such as ideological, political and professional training, aesthetic education, promoting creative imagery, furthering refinement of speech

and fistering emotions.

Continuous renovation of course content is a major vehicle for improving higher education, and with increasing scientific and technological progress renewal of content must become more frequent.

The audio-visual media seem to be unique in this respect. "Discovered by science, and applied in life today - included in a college course tomorrow" - this motto which but recently might have been taken for a fruit of fantasy is becoming an everyday occurence with creatively-minded teachers who assess the instructional resources of AV media both in practice and theory.

Presently, a printed lecture, a text-book, an instructional film or even a slide is outdated as soon as it is created. Scienc and its application are developing so fast that much of what is just found or discovered grows obsolete before it gets into text-books or lecture courses. The audio-visual media make it possible for faculty to deliver up-dated instructional information to learners.

The accelerating growth of documentary scientific and technological information, the "information explosion", leads to a situation where a scientist and, hence, a teacher, who is called upon to train would-be researchers and to carry out research, have to spend more and more time on acquainting themselves with all relevant works.

Television has much to offer to solve this problem. New scientific and technological information obtained by one teacher and used in lectures promptly joins a pool of information available for broadcast programmes or exchanges to be shown on closed-circuit television.

The use of visual information in teaching-learning situations is a superior way of reflecting reality as fully and as objectivel

as is possible and enhances the creative potential of prospective specialists. Recording real-life phenomena makes it possible to reproduce individual experiments in classroom conditions.

The teacher should select exercises and problems for presentation to his class that describe specific real-life situation - contradictory and dynamic - which require one to transcend the bounds of one's narrow professional orientation. Any social collision in the sphere of productional, moral, national or family relations among people can be used. The audio-visual media are superb in producing factual tissue for exercises of this kind, as broadcast television is a rich course of relevan material.

Professional education and development is one of the most important aspects of training specialists at institutions of higher learning. Higher education must prepare its undergraduate for professional activity. Thus, the goal of transforming knowledge into a professional activity is an essential educational goal.

The audio-visual media transport learners into the world of their future profession and vividly demonstrate to them both its attractive features and the difficulties that are in store for them. Far from being a mere tool to set forth scientific facts, concepts and laws, and to disclose the way they manifest themselves, the audio-visual media can show the spheres of application of natural laws being studied in real-life conditions. They can approximate real working conditions. Such situations arranged around problem-oriented cores and perceived on several levels simultaneously can develop a capacity for decision-making.

The visual presentation of instructional material is very important for the development of visual thinking, which has essential gnosiological and controlling functions in Man's mental activity. Indeed the mental capacity to process images has a significant influence on the rate and quality of information

processing at all intellectual levels.

It would seem that it is in the context of using images in thought that we should consider the role of imagination in learning. There are elements of imagination even in the simplest creative efforts. The contribution to the teaching-learning process the audio-visual media can make in this respect is inestimable: the visual component functions here not only as a constituent of the overall source of information but also as an incentive for the development of imagerial thinking.

The aesthetic education of students has an important role to play in the formation of their professional excellence. When we come to discuss aesthetic education as an element of curriculum content we should emphasize the immense educational charge contained in science and in scientific disciplines. One would hardly be able to name a college subject which does not involve elements of aesthetics. Such basic aesthetic categories as colour, sound, form, and such notions as harmony, symmetry, proportionality, rhythm are to be found in nearly every scholastic subject.

Contemporary science and advanced technology demand of Man an ever higher standard of visual culture. This requirement will soon become as indispensable as that for language refinement. Visual culture is developing into an essential component part of the professional aspect of many kinds of human activity. Development of effective methods aesthetic education, a task urgent in itself, assumes a special importance in this broader context.

The audio-visual media, capable of embodying aesthetic categories in screened instructional messages, have a serious role to play in the aesthetic education of college students.

Profound aesthetics in the teaching-learning process is associated with the joy of cognition and discovery, if only personal, and with the satisfaction of Man's need to search. An aesthetic attitude towards reality is what must be conveyed in a screened presentation.

BEST COPY AVAILABLE

It is still early to make sweeping assumptions. We have many more experimental programmes to make, and many more learning situations, with and without the intervention of new technologies, to observe, record, and assess.

But one thing is clear beyond any doubt: modern media have entered the educational system to stay, and the contemporary teaching learning process at any stage of the educational ladder including higher education, is liable to lack efficiency unless it rests, among other things, on the scientifically sound use of new technologies.

Also available on request:

Complete list of documents available free from the Division
Catalogue of Unesco publications
Sample copy and subscription information on
Prospects, quarterly review of education

For information, write to: Division of Structures, Content, Methods, and Techniques of Education (ED/SCM)
Unesco, 7, place de Fontenoy
75700 Paris, France